

MATERIEL

M1 MINE CLEARING BLADE

BACKGROUND

- **Type Classified 1986**
- **Produced 500 Units**
- **First Unit Equipped 1990**
- **Basis of Issue:**
 - 12 Per Armor Battalion**
 - 9 Per Armored Cavalry Regiment**

CAPABILITY

- **Countermining Breaching Asset**
- **Clear Path 42 inches Per Side & T**
- **Clears Magnetic Fused Mines Between Plows with Improved Dogbone Assembly**
- **Maximum Safe Operating Speed < 10 mph**



MATERIAL

M1 MINE CLEARING ROLLER

BACKGROUND

- **Roller Type Classified 1983**
- **M1 Mounting Kit Type Classified 1986**
- **Produced 195 Rollers & 276 Mounting Kits**
- **First Unit Equipped 1990**
- **Basis of Issue: One per Armor Company**

CAPABILITY

- **Countermine Detection & Proofing Assembly**
- **Clears 44 Inch Path (per side) of Single Pulse Pressure Fused Mines & Tilt-Rod Mines Between the Rollers**
- **Clears Magnetic Fused Mines Between Rollers with Improved Dogbone Assembly**
- **Maximum Safe Operating Speed < 10 mph**



LESSONS LEARNED

- **During a 14-day rotation at the NTC, a typical BN / TF has an average of two out of six tank mine plows fully mission capable (FMC) for any given mission.**
- **Three plow maintenance failures account for approximately two thirds of all NTC plow failures:**
 - **Broken lifting straps.**
 - **Inoperative electric lifting motor.**
 - **Sheared travel lock spindle and brackets.**

LESSONS LEARNED

BROKEN LIFTING STRAPS:

- The nylon lifting straps that raise and lower the blade suffer much abuse, and are cut and frayed by concertina wire or other sharp objects. They then break under load. **Technique:** to prevent damage to the straps, some units bolt wire catchers, similar to those on the old M-151 bumper, on the moldboard in front of the straps.
- The straps also break frequently when the crew attempts to lift the blade with spoil on it. Result: the straps bear the additional load of the spoil, and they break.

LESSONS LEARNED

INOPERATIVE ELECTRIC LIFTING MOTOR.

- The most common problems with the motor are that the armature brushes burn out or one of several electrical relays malfunctions. The only authorized repair for burn-out brushes is to have a DS-level mechanic replace the entire motor. The German-made motors often take several months to come in after ordering. **Technique:** (used by NTC contract mechanics): file the brushes from an old M-1 or M-2/3 starter down to size and place them in the lifting motor. Result: plow downtime reduced from several months to three or four hours.
- The electrical relays are not particularly hard to acquire through normal supply channels, but most tank units do not keep them on hand. **Technique:** in a pinch, check with a sister mechanized battalion for the part.

LESSONS LEARNED

SHEARED TRAVEL LOCK SPINDLE AND BRACKETS.

- **The travel lock spindle usually shears when the blade drops or hits something while the vehicle is moving at high speeds. When the spindle shears off, the downward motion of the blade causes the remainder of the spindle to bend or break the bracket in which it is mounted. For some reason, the spindles on the left travel lock break considerably more often than the right and, in every case, the bracket breaks through the bolt holes. The only way to fix the bracket is to replace the entire pushbeam. This is a very time-consuming operation, which the crew can avoid if they use caution when driving with the blade.**

LESSONS LEARNED

SHEARED TRAVEL LOCK SPINDLE AND BRACKETS CONTINUED

- Once the plows break, units seldom get the parts to repair them during the rotation. Most units maintain very little, if any, PLL for the plow since it is a kit and not a reportable item. Units are reluctant to add these additional lines to their already limited PLL listing. Therefore, they must order the repair parts which have an exceptionally slow turnaround time. **Technique:** the items listed (see figure 2) are a sample PLL stockage listing for a battalion equipped with 12 blades. These items are based on a 12-month demand history at the NTC. Result: rapid plow repair on the battlefield.

LESSONS LEARNED

- **Sample PLL stockage listing for a battalion equipped with 12 blades. These items are based on a 12-month demand history at the NTC. Result: rapid plow repair on the battlefield.**

NSN	NOMENCLATURE	U/I	QTY
4010-01-278-1216	Cable, Emergency Release	ea	2
2510-01-276-7138	Pushbeam, L.H.	ea	1
4010-01-277-5653	Preventive Chain Assy.	ea	2
4020-01-289-8249	Strap, Lifting	ea	6
5945-01-277-0085	Solenoid	ea	2
5945-01-277-0087	Solenoid Limit Switch	ea	2
5945-00-500-7195	Relay	ea	1
5945-00-686-6877	Relay	ea	1
6105-01-277-0295	Motor, 3 H.P.	ea	1
5315-01-277-5641	Pin, Attaching	ea	2
3040-01-K44-2243	Link	ea	1
5315-01-277-5643	Spindle	ea	4
3120-01-277-5652	Travel Lock Roller	ea	4

Figure 2. Recommended PLL Listing.

LESSONS LEARNED

CREW-LEVEL TRAINING

- **Proper crew-level training can prevent the majority of the mechanical failures and mine-related casualties for plow crews.**
- **Proper plow training will lead to more rapid, effective obstacle breaches, which will increase the probability of overall mission success.**
- **However, many crews arrive at the NTC with little or no formal training or experience with the mine plow.**

LESSONS LEARNED

CREW-LEVEL TRAINING

Causes of the problems:

- **Lack of an army-wide comprehensive training and licensing program for tank crews. Such a program would ensure that crews meet the standard before operating the plow on the battlefield.**
- **Unit apprehension about using the plow in training for fear of breaking it, or because the unit has no operational plows with which to train.**

LESSONS LEARNED

CREW-LEVEL TRAINING

Causes of the problems continued:

- **Most units only train those crews assigned to plow tanks. Technique: due to vehicle maintenance, or other tactical considerations, non-plow crews often must employ the plow in a battle, and the results are disastrous. Units should thoroughly train and license all tank crews on the plow tank.**
- **There is no single source manual for all of the crew-level tank mine plow doctrine, tactics, techniques and procedures.**

LESSONS LEARNED

CREW-LEVEL EMPLOYMENT SKILLS PLAN

- **Many leaders fail to consider the effect the 7,560-pound blade kit (plow) has on the tank when they develop their plans. While the plow has little effect on the tank's overall speed, it greatly reduces its maneuverability in rough terrain.**
- **Crews who try to traverse rough terrain at high speeds cause most of the mechanical failures by ramming the plow into rocks, wadis, etc. In many cases, the crews are simply trying to keep up with the rest of the unit.**

LESSONS LEARNED

CREW-LEVEL EMPLOYMENT SKILLS PLAN CONTINUED:

Techniques:

- **When planning movement or maneuver routes, keep the rate of movement to a speed the plow tanks can safely negotiate.**
- **Position the plow tanks on the right side of the unit formation if possible. Drivers of plow tanks cannot see to the right side of the tank because the power cable enters the tank through the right periscope opening. This makes it difficult for the driver to maintain formation and interval without a lot of guidance from the TC.**

LESSONS LEARNED

PREPARE

Problem:

- **Drivers often inadvertently leave the on/off power switch on the control box in the "on" position. Subsequently, they sit or step on the raise/lower switch and cause the lifting motor to engage while the plow is in travel lock. Result: this quickly burns out the lifting motors and the relays.**

Technique:

- **Securely mount or stow the control box in the driver's compartment and disconnect the main harness from the slave receptacle until ready for actual use.**

LESSONS LEARNED

PROBLEM:

- Crews neglect to properly prepare the blade prior to an operation. Result: many real-life and simulated battle-damage casualties and failures.

Techniques:

- Attach the moldboard extensions to ends of the moldboards before plowing. Result: the extensions push the spoil and mines clear of the lane so they do not roll back down under the plow tank's tracks.
- Ensure the travel-lock hitch pins are in the travel lock until it is actually time to drop the plow. Result: this prevents the travel lock from disengaging prematurely and dropping the blade.

LESSONS LEARNED

Techniques continued:

- **12-inch depth, based on the expected soil type - the softer the soil, the greater the depth. The plow will not work effectively in some types of soil - rocky or frozen ground.**
- **Secure the emergency release cable handle near the driver's hatch with tape or a strap. Result: when the driver has to use the emergency release to lower the plow, he will not have to climb out of the hatch to reach it. A piece of 100-mph tape will hold it in place by the driver's hatch.**

LESSONS LEARNED

Techniques Continued:

- **Adjust the plowing depth to an 8-inch, 10-inch, or stow the manual lifting strap and the tools required to open the no. 1 skirt together in an easily accessible place. Result: allows the crew to rapidly secure them and raise the blade manually if necessary.**

LESSONS LEARNED

Crew Level Execution Techniques:

- **When you receive the order to initiate plowing, seek cover if possible, pull the travel-lock hitch pins, attach the main electrical harness to the slave receptacle, and move to the beginning of the lane. Do not move the tank at high speeds with the travel-lock pins removed as the plow is likely to drop unexpectedly and damage the plow and injure the crew.**
- **At the beginning of the lane, orient the tank in the proper direction of travel before dropping the blade. The blade achieves the best plowing width during straight-line plowing**
- **Close all of the hatches and traverse the main gun tube to the side to prevent damage by mine detonation under the blade.**

LESSONS LEARNED

Crew-level Techniques Continued:

- **Do not drop the plow too close to the minefield. Result: plow does not reach proper plowing depth prior to striking the first mine. FM 20-32, mine/countermine operations, states the lane should begin 100 meters from the estimated leading edge of the minefield. The lane should also extend for another 100 meters beyond the estimated far edge of the minefield to ensure it extends through the entire minefield. This allows for a tactical safety factor.**
- **TM 9-2590-509-10 states the crew must lower both moldboards at least 32 feet (10 meters) prior to the beginning of the cleared lane to allow the moldboards to reach operating depth. Therefore, in a deliberate breach situation, drop the plow 100 meters out from the minefield and begin plowing; if you make unexpected contact with a minefield, ensure you begin plowing at least 10 meters from the first visible mine, even if you have to back straight up first.**

LESSONS LEARNED

Crew-level Techniques Continued:

- **You can lower the mine plow while the tank is moving up to 8 to 10 mph (13 to 16 kph). However, you should use caution when lowering the blade while moving. It can cause damage to the blade and injure the crew.**
- **When operating laterally on a slope, always drop the uphill plow first.**
- **Although the blades will plow through concertina wire effectively, the wire will often cut the nylon lifting straps - avoid wire if possible.**
- **At the conclusion of plowing, back up the tank approximately two meters to clear the blade from the spoil prior to lifting. Otherwise, the additional weight of the spoil may break the lifting straps.**

LESSONS LEARNED

Tactical Employment

- **The individual and crew-level skills required to operate the tank mine plow are the foundation for proper tactical employment. Units equipped with plows should train all tank crews in the use of the plow.**
- **Trained crews give BN / TF level tactical planners confidence in planning the employment of tank mine plows and using the asset to its fullest potential.**

LESSONS LEARNED

TACTICAL EMPLOYMENT PLAN

- **Effective breaching operations begin in the planning phase. Task organization of the tank mine plows is a critical first step. **Technique:** to become a reliable breaching asset, commanders should mass all mine plow tanks. (FM 71-123, p. 6-107) this is a tactical decision based on METT-T.**
- **Result: massing plow tanks together achieves more consistent results because of easier command and control and the ability to rehearse as a team.**

LESSONS LEARNED

Tactical Employment:

- **Breach site selection is another planning task. Plows perform better on flat terrain. Terrain analysis will reveal the most advantageous ground to plow on. A rapid increase or decrease in elevation affects the depth setting on a plow, making it harder to maintain the proper amount of spoil in front of the blade.**

Technique:

- **The commander should visualize the breach site in his OPORD. Use terrain overlooking the site or a terrain model. Place emphasis on the critical actions that occur in the vicinity of the breach site, including when and where to release the travel-lock hitch pins and drop the blade, and where to begin plowing.**

LESSONS LEARNED

Prepare

- **Rehearsals are critical in the employment of the tank mine plow. A "full-up" rehearsal on similar terrain is the most effective way to prepare crews. If time does not permit a full-up rehearsal, crews should at least drop the blade and plow a few meters to ensure the depth setting is appropriate.**

Technique:

- **Commanders should rehearse redundancy when employing plows. Rehearsing the exact order the commander intends to employ the plows, and their relation to the support force will increase the survivability of the crews. Coupled with thorough pre-combat inspections of the blade, this should limit the number of surprises at the breach site.**

LESSONS LEARNED

Execute - to successfully execute the breach, units have to protect the blade tanks.

Technique:

- **Allow the plow crews to find a covered and concealed position to prepare for operations, then direct the crews to the beginning of the lane.**
- **Before directing crews to the beginning of the lane, the commander should ensure that conditions have been set for successful plow employment. Setting the conditions includes:**
 - **Suppressing enemy direct fire systems before the commitment of the plow tanks, as the enemy will target them immediately.**
 - **Obscuring enemy observation of the breach site. Use artillery-delivered smoke and smoke pots on the enemy side of the obstacle.**
 - **Securing the breach site.**

LESSONS LEARNED

Execute:

- **Correct employment sequence (FM 71-1, p. 3-45)**

Procedure:

- **Lead with a mine roller to identify the edge of the minefield.**
- **Fire and detonate an M173-projected demolition charge, or MICLIC, to destroy most of the mines in the lane.**
- **Proof the lane with a mine roller or a mine plow.**

Technique:

- **Since most units do not have or use the mine roller, they must visually identify the edge of the minefield, then fire the MICLIC and proof the lane with the mine plow. Simply plowing through the minefield without first firing the MICLIC is a high-risk operation, as the first few mines are likely to disable the plow and the crew.**

LESSONS LEARNED

- **The tank mine-clearing blade (plow) is a valuable asset which, when maintained and employed correctly, will significantly enhance a unit's ability to mechanically breach obstacles.**
- **Proper blade training and maintenance will result in fully mission-capable equipment and trained crews available when the mission requires it.**

LESSONS LEARNED

Desert Shield / Storm Observations: tank mounted mine plows were very successful in South West Asia breaching minefields.

- **Discussion: track width mine ploughs proved very successful against pressure fused anti-tank mines**
- **Allowed the M1 to breach minefields with little loss of momentum**
- **Plows could operate at a rate of 30 k/h in loose sand**
- **Units discovered that the plow was useful in pushing up berms, clearing trench-lines, and delineating counter-attack routes and lager sites.**

TRAINING

- **Most critical piece of the puzzle**
- **Lack of crew training causes mechanical failure or maintenance problems**
- **In turn, frequent maintenance problems prevent crew training on the systems**
- **What has worked for us?**
 - **Battalion scheduled focused maintenance days**
 - **Establish NCO experts to implement a program**

TRAINING

What has worked?

- **Leader training, teach what “right” looks like**
 - **Hands-on and NCOPDs**
 - **Establish the training standard**
- **Soldier training:**
 - **Planned, rehearsed and conducted by NCOs**
 - **Supervised and evaluated by leadership**
 - **Maintenance is training, training is maintenance**
 - **Charge NCOs With responsibility and hold NCOs accountable**

LEADER DEVELOPMENT

Leaders must know what right looks like



SOLDIER

- **Must have applicable technical manuals to properly maintain their equipment**
- **Plow/roller crews must have confidence in their equipment**
- **Quality training will provide the confidence required to operate and maintain his equipment**



CONCLUSION

- **The tank mine clearing blade and roller are valuable assets**
- **When maintained and employed correctly, will significantly enhance a units ability to mechanically breach obstacles**
- **Proper training and maintenance will result in fully mission-capable equipment and trained and ready crews**



DOCTRINE REFERENCES

- FM 71-123. TACTICS AND TECHNIQUES FOR COMBINED ARMS HEAVY FORCES: ARMORED BRIGADE, BATTALION TASK FORCE, AND COMPANY TEAM, 30 SEP 1992
- FM 71-1. TANK AND MECHANIZED INFANTRY COMPANY TEAM, CHAPTER 5 SECTION 6, 26 JAN 1998
- FM 5-71-2. ARMORED TASK-FORCE ENGINEER COMBAT OPERATIONS, 28 JUN 1996 , CHANGE 2, 4 SEPTEMBER 1997
- FM 3-34.2. COMBINED-ARMS BREACHING OPERATIONS, CHANGE 2, 26 FEBRUARY 2001
- FM 3-20.15. TANK PLATOON, 01 NOV 2001

TRAINING REFERENCES

- **FKSM 17-13-1-MTP, 22 SEPTEMBER 1997**
 - **17-5-5517.17-OKRX, EMPLOY THE MINE CLEARING BLADE ON AN M1/M1A1/M1A2 TANK**
 - **051-192-4053 SUPERVISE MINEFIELD BREACHING OPERATIONS**
 - **171-126-1086 PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) ON THE MINE-CLEARING BLADE ON AN M1/M1A1 TANK**
 - **171-126-1087 OPERATE THE MINE-CLEARING BLADE ON AN M1/M1A1 TANK**
 - **171-126-1088 PERFORM TROUBLESHOOTING PROCEDURES ON THE MINE-CLEARING BLADE ON AN M1/M1A1 TANK**
 - **171-126-1119 EMPLOY A MINE-CLEARING PLOW ON AN M1/M1A1 TANK**

TRAINING REFERENCES

- **FKSM 17-13-1-MTP, 22 SEPTEMBER 1997**
 - **171-5-5518.17-OKRX EMPLOY THE MINE CLEARING ROLLER ON AN M1/M1A1/M1A2 TANK**
 - **171-126-1092 UNLOAD A MINE-CLEARING ROLLER KIT FROM THE TRAILER**
 - **171-126-1094 PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) ON THE MINE-CLEARING ROLLER ON AN M1/M1A1 TANK**
 - **171-126-1097 OPERATE THE MINE-CLEARING ROLLER ON AN M1/M1A1 TANK**
 - **171-126-1098 RELEASE THE PUSHBEAM/ROLLER ASSEMBLY OF THE MINE-CLEARING ROLLER ON AN M1/M1A1 TANK**
 - **171-126-1099 OPERATE THE WINCH ON THE MINE-CLEARING ROLLER ON AN M1/M1A1 TANK**
 - **171-126-1100 EMPLOY A MINE-CLEARING ROLLER ON AN M1-SERIES TANK**
 - **171-126-1131 INSTALL THE MINE ROLLER KIT ON AN M1/M1A1/M1A2 TANK**

TRAINING AID REFERENCES

AUDIO/VISUAL TRAINING AIDS

- **VIDEO, M-1 MINE CLEARING ROLLER AND BLADE, 1990**
- **NATIONAL TRAINING CENTER, COMBINED ARMS BREACHING
30:10
<http://call.army.mil/homepage/video.htm>**
- **NATIONAL TRAINING CENTER, MINE PLOWING TECHNIQUES
15:19
<http://call.army.mil/homepage/video.htm>**
- **JOINT READINESS TRAINING CENTER, COMBINED ARMS ROUTE
CLEARANCE 29:42, <http://call.army.mil/homepage/video.htm>**

TECHNICAL MANUAL REFERENCES

TECHNICAL MANUALS

- **TM 5-2590-214-10 OPERATOR'S MANUAL FOR THE ROLLER KIT, MINE, AND MOUNTING KIT, MINE CLEARING ROLLER**
- **TM 9-2590-509-10 OPERATOR'S MANUAL FOR THE MINE CLEARING BLADE FOR THE M1 OR M1A1 ABRAMS TANK**